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93. Proposed by CHARLES CARROLL CROSS, Libertytown, Md.

Given  $x^x + y^y = 285$ , and  $y^x - x^y = 14$ , to find the values of  $x$  and  $y$ . [From *Bonnycastle's Algebra*, 1841.]

\*\*\* Solutions of these problems should be sent to J. M. Colaw not later than January 10.

### GEOMETRY.

108. Proposed by NELSON L. RORAY, Bridgeton, N. J.

$ABC$  is a triangle.  $O_1, O_2, O_3$  centers of escribed circles. Prove altitudes of triangle  $O_1 O_2 O_3$  are concurrent at center of inscribed circle.

109. Proposed by CHARLES CARROLL CROSS, Libertytown, Md.

Two circles, radii in ratio 3:1, centers  $A$  and  $O_1$  respectively, are drawn tangent externally to each other and internally to a given circle  $O$ , and on the same diameter;  $O_2$  and  $O_2'$  are drawn tangent internally to  $O$  and externally to  $A$  and  $O_1$ ;  $O_3$  and  $O_3'$  are drawn tangent internally to  $O$  and externally to  $A$  and  $O_2$ ;  $O_3$  and  $O_3'$  are drawn tangent internally to  $O$  and externally to  $A$  and  $O_2$ ,  $A$  and  $O_2'$ , respectively; and so on. Prove  $O_4, O, O_4'$ ;  $O_5, A, O_5'$ ;  $O_9, A, O_3'$  and  $O_{10}, O, O_2'$  are collinear. [The letters apply to the centers of the circles.]

110. Proposed by P. S. BERG, A. M., Principal of Schools, Larimore, N. D.

If the three face angles of the vertical trihedral angle of a tetraedron are right angles, and the lengths of the lateral edges are represented by  $a, b$ , and  $c$ , and of the altitude by  $p$ , then  $1/p^2 = 1/a^2 + 1/b^2 + 1/c^2$ . [*Chauvenet's Geometry*.]

\*\*\* Solutions of these problems should be sent to B. F. Finkel not later than January 10.

### CALCULUS.

83. Proposed by J. SCHEFFER, A. M., Hagerstown, Md.

From a given point,  $P$ , in the base  $AB$  of a triangle, to inscribe in the latter the minimum triangle, if its angle at  $P$  is given.

84. Proposed by C. HORNING, A. M., Professor of Mathematics, Heidelberg University, Tiffin, Ohio.

Find the equation of the curve upon which a given ellipse must roll in order that one of its foci may describe a straight line.

\*\*\* Solutions of these problems should be sent to J. M. Colaw not later than January 10.

### MECHANICS.

77. Proposed by ELMER SCHUYLER, High Bridge, N. J.

At what elevation must a shell be projected with a velocity of 400 feet that it may range 7500 feet on a plane which descends at an angle of  $30^\circ$ ?

78. Proposed by ALOIS F. KOVARIK, Professor of Mathematics, Decorah Institute, Decorah, Iowa.

A cone and a cylinder having equal heights and equal circular bases are filled with